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Digital Transformation?

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CHAPTER 4

Russia's Digital Economy Program: An Effective Strategy for Digital Transformation?

Anna Lowry

4.1 Introduction

The impact of new technological innovations is all-pervasive today from altering consumer preferences in the direction of highly customized on-demand products to changing the way companies create, market, and deliver goods and services, in particular through increasing reliance on technology-enabled platforms. Currently, digital technologies are changing the business model of companies, especially in the banking and telecommunications sectors, while increasing efficiency and revealing new market opportunities. Even traditional industries increasingly employ methods for analyzing large volumes of data to make effective management decisions. The Internet of Things improves the quality of equipment operation, increases productivity of oil and gas fields, and makes urban infrastructure more energy efficient. In the next decade, the further development of such innovations as unmanned aerial vehicles (drones), augmented reality, block chain, robotics, and artificial intelligence will open up a wide range of opportunities for consumers, business, and governments (Aptekman et al. 2017).

In Russia, the digital transformation of the economy is becoming one of the main strategic directions of its development (Jakutin 2017). In his address to the Federal Assembly in December 2016, President Putin set the task of preparing a digital economy program. The President has repeatedly called attention to the challenges of Russia's digital transformation, most notably in his speech at the St. Petersburg Economic Forum in June 2017. This provided an

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impetus for the subsequent discussion of the digitalization strategy at various discussion platforms in Russia. Within a month, almost all major Russian business associations and scientific communities held meetings, seminars, and conferences on digital issues. The public discussions became the basis of the organizational work on the formation of a digital transformation strategy for the Russian economy in the government's program (for more on digital government, see Chap. 3). Approved by the Presidential Council for Strategic Development and Priority Projects, the Digital Economy Program acquired the status of an official government document already in July 2017. On July 28, 2017, Prime Minister Medvedev signed a governmental order approving the program "*Cifrovaâ èkonomika Rossijskoj Federacii*" (Digital Economy of the Russian Federation).[1] Subsequently, national projects in 12 areas of strategic development were established.[2] One of these is the national program "Digital Economy of the Russian Federation," approved by the Presidential Council for Strategic Development and National Projects[3] on December 24, 2018 (Pasport 2018), and created on the basis of the Digital Economy Program (2017).

4.2 Putting "Digital" in Perspective: Theories of Technological Change

Despite the widespread use of the term "digital economy," it remains a fuzzy and contradictory concept. It is usually understood as all types of economic activity based on digital technologies, including e-commerce, Internet services, electronic banking, entertainment, and others. However, it is not clear where the precise boundary between digital and "analog" economies is now (Grammatchikov 2017). Additionally, economists note the contradiction in the term itself, suggesting that in economics, all processes have long been described, diagnosed, and projected using digits/numbers (Jakutin 2017, 32; Ivanov and Malineckij 2017, 4).

Digital transformation of the economy occurs under the influence of innovation waves (Aptekman et al. 2017, 21). The first wave of digital innovations, starting from the 1960s, involved automation of existing technologies and business processes. Starting from the mid-1990s, the rapid development of Internet technologies, mobile communications, social networks, and the emergence of smartphones have led to the widespread use of technology by end consumers. In the broader scientific context, these innovation waves, or interrelated radical breakthroughs, form a constellation of interdependent technologies defined as a *technological revolution*. Carlota Perez (2002, 2010) identifies five such revolutions since the initial Industrial Revolution in England. Each technological revolution is accompanied by a set of "best-practice" principles—a *techno-economic paradigm*—which guides a vast reorganization of economic and social institutions.

In Russian literature, digital transformation is often associated with the transition to the sixth technological order, or *tehnologičeskij uklad* (Glaz'ev 1993, 2010). A technological order is defined as a complex of technologies characteristic of a certain level of development of production. Each technological order encompasses a closed cycle from the extraction of primary resources to all stages of their processing to the production of products that meet the relevant level of public consumption (Rodionov et al. 2017, 80). In this framework, digital economy is understood as a form of economic organization of society, resulting from scientific and technological progress, aimed at creating greater value with the use of technology of the sixth technological order and enabling its long-term sustainable development (Rodionov et al. 2017, 79). Digital transformation is conceptualized as the material embodiment of nano- and biotechnologies, artificial intelligence, the Internet of Things, robotics, and other modern technologies based on electronic devices (Jakutin 2017, 28). With regard to the Russian economy, its digital transformation is seen as part of a broader task of economic modernization, moving away from its raw-materials orientation.

4.3 Russia on the Global Digital Market

There are a number of studies that seek to identify the leaders of the digital economy and calculate its share in the gross domestic product (GDP) of different countries. According to the latest McKinsey study (Aptekman et al. 2017), Russia's digital economy accounts for 3.9 percent of its GDP, compared to 10.9% in the United States (US), 10% in China, and 8.2% in the European Union (EU, in 2015 prices). At the same time, digital transformation is one of the main factors of economic growth in Russia as well as globally. From 2011 to 2015, the total volume of Russia's digital economy increased by 59%, which means that it is currently growing at a rate that is 9 times faster than the country's GDP. Based on this considerable growth potential, the study suggests that it is possible to triple the size of Russia's digital economy by 2025 from the current 3.2 to 9.6 trillion rubles, which would bring Russia to the level of developed economies in terms of the relative share of digital economy in GDP (8–10%).

To assess Russia's relative position on the global digital market, it is possible to use relevant international indices. The Networked Readiness Index, developed by the World Economic Forum, measures countries' preparedness to reap the benefits of emerging technologies and to capitalize on the opportunities presented by the digital revolution (Baller et al. 2016). It is made up of four main categories—environment (political/regulatory and business/innovation), readiness (measured by information and communication technologies (ICT) affordability, skills, and infrastructure), usage (individual, business, and government), and impact (economic and social). Russia ranks 41st in the Networked Readiness Index 2016, far behind the leading countries such as Singapore, Finland, Sweden, Norway, the United States, the Netherlands,

Switzerland, the United Kingdom, Luxembourg, and Japan. Russia's relatively weak position in the ranking can be attributed to the gaps in the regulatory framework for the digital economy and the insufficiently favorable environment for innovation and doing business, and consequently, low ICT business usage (Programma 2017, 8).

Another relevant index is the International Digital Economy and Society Index (I-DESI) developed by the European Commission to measure the digital economy performance of EU28 Member States and the EU as a whole compared to 17 other countries (Wiseman et al. 2018). It is a composite index that comprises 5 dimensions: connectivity, digital skills, citizen use of Internet, business technology integration, and digital public services. Based on this index, Russia lags behind the EU average but is still ahead of China, Chile, Mexico, Turkey, and Brazil (Wiseman et al. 2018, 14). Russia ranked above the EU average in terms of human capital (digital skills) but fell behind in the other 4 dimensions. It received the lowest rating among the 45 countries in the study in terms of overall connectivity and was ranked below the EU bottom 4 in terms of business technology integration (for more, see Chap. 13).

4.4 Analysis of the Digital Economy Program: Definitions, Goals, and Indicators

This section provides an analysis of the program's content in terms of its definitions, goals, and indicators. It focuses on the 2017 state program as a conceptual document laying the framework for the subsequent national program (2018), which is more target oriented. The analysis also shows how the broadly formulated goals of the original program have been redefined and fine-tuned in the 2018 national program with more concrete tasks, indicators, and mechanisms of implementation.

4.4.1 Definition of the Digital Economy

The state program defines digital economy as "an economic activity, in which the key factor of production is data in the digital form" (Programma 2017, 4–5). In classic economic theory, labor, capital, and raw materials are considered the main factors of production. In the context of innovative economy, technology and knowledge also play a key role in production. However, it is not clear why data in digital form should be considered the main factor of production (Ivanov and Malineckij 2017, 6). The authors of the program provide the following explanation: "Currently data become a new asset, mainly due to their alternative value, that is, as data are used for new purposes and realization of new ideas" (Programma 2017, 5). At the same time, the program does not specify these new purposes. A related criticism is that "data in the digital form" do not define the essence of today's digital economy since data have always

been used to describe and evaluate economic activity (Jakutin 2017, 32). A simpler and more straightforward definition of the digital economy would have been as an economy based on digital technologies. Consequently, strategic management of the digitalization processes of the Russian economy would entail, first, the management of the development of digital technologies and, second, the management of the processes of their deployment in the economic sphere (Jakutin 2017, 36).

4.4.2 Goals of the Programs

The 2017 program outlines its three main goals as follows. The first goal is "creation of the ecosystem of the digital economy of the Russian Federation," which ensures effective interaction between business, scientific and educational community, the state, and Russian citizens. This goal is weakly formulated and can hardly claim the status of a long-term target of government activities on digitalization. The "Strategy for the Development of the Information Society in the Russian Federation for 2017–2030" defines the "ecosystem of the digital economy" as "a partnership of organizations ensuring the continuous interaction of their technological platforms, applied Internet services, analytical systems, information systems of public authorities of the Russian Federation, organizations and citizens" (Strategiâ 2017, 5). Thus, the creation of the ecosystem of the digital economy entails the creation of "a partnership of organizations." However, a partnership is not the main element of the digital economy (Jakutin 2017, 41). Regardless of whether enterprises-owners of digital technologies, Internet portals, and servers form or do not form a partnership, the economy does not cease to be digital.

The second goal is defined as "the creation of necessary and sufficient institutional and infrastructural conditions, the removal of existing obstacles and restrictions for the creation and (or) development of high-tech businesses and the prevention of the emergence of new obstacles and restrictions both in traditional industries and in new industries and high-tech markets" (Programma 2017, 2). This goal is too big and too compressed in its content. It can be subdivided into two separate strategic objectives: the formation of the institutional environment of Russia's digital economy and the creation of its infrastructure.

The third goal is increasing competitiveness of Russian industries and the economy as a whole on the global market. However, this goal cannot be considered one of the directions of digitalization. Competitiveness is itself a result of the development of the digital economy. While improving competitiveness is a necessary task, it requires an active and diverse economic policy. The program lacks such a policy (Jakutin 2017, 45).

The national program "Digital Economy of the Russian Federation" (2018), developed on the basis of the 2017 program, redefines the goals as follows. The first goal is a three-fold increase in domestic spending on the development of the digital economy from all sources (by share in GDP) compared to 2017.

The second goal is "creating a sustainable and secure information and telecommunications infrastructure for high-speed transmission, processing and storage of large amounts of data that is accessible to all organizations and households." The third goal is the use of predominantly domestic software by government agencies, local governments, and organizations. Thus, compared to the earlier program, the national digital economy program has more concrete goals. Consequently, the indicators have also been redefined accordingly. They are shown in Table 4.1.

The redefined and more concrete goals, with corresponding indicators, of the subsequent national program (2018) are a significant improvement on the original version of the program. In this regard, the shift from a very broadly formulated goal of creating the ecosystem of the digital economy to the more concrete objective of increasing domestic expenditures on the development of the digital economy, with fine-tuning of the necessary methodology, should be noted. Compared to the earlier version, the use of domestic software by government agencies is elevated to one of the main goals of the program. In the 2017 program, these measures were addressed under the rubric of information security with corresponding indicators for decreasing the share of foreign ICT equipment and software in the purchases of federal and regional government authorities and state-owned enterprises (SOEs). The new program uses different indicators for government bodies and SOEs but focuses exclusively on software, omitting ICT equipment. In sum, the program has been revised so that

Table 4.1 Main indicators of the national program "Digital Economy of the Russian Federation" (2018)

No.	*Program indicators*	*2018*	*2019*	*2020*	*2021*	*2022*	*2023*	*2024*
1.1	Domestic spending on the development of the digital economy by share in GDP (%)	1.9	2.2	2.5	3.0	3.6	4.3	5.1
2.1	Share of households with broadband access to the Internet (%)	75	79	84	89	92	95	97
2.2	Share of socially significant infrastructure objects with broadband access to the Internet (%)	34.1	45.2	56.3	67.5	83.7	91.9	100
2.3	Availability of data processing centers in federal districts (quantity)	2	3	4	5	6	7	8
2.4	Russia's share in the world volume of storage and data processing services (%)	–	–	1.5	2	3	4	5
2.5	Average downtime of public information systems as a result of cyberattacks (hours)	65	48	24	18	12	6	1
3.1	Cost share of domestic software purchased and (or) rented by federal, regional, and other government authorities, %	>50	>60	>70	>75	>80	>85	>90
3.2	Cost share of domestic software purchased and (or) rented by state corporations and companies with state participation, %	>40	>45	>50	>55	>60	>65	>70

Pasport (2018)

there is a better fit between the goals, specific measures to be implemented, and target indicators. However, much of the original criticism regarding the lack of measures for streamlining the production of domestic ICT equipment remains valid. Similarly, there are no indications in the program that it is aimed at addressing import dependence in the component base of hardware or creating mechanisms to overcome the rigid sanctions regime applied to Russian high-tech companies (Jakutin 2017, 37).

4.4.3 Levels of the Digital Economy

According to the program, the digital economy comprises three levels: *markets and industries*, where the interaction of specific subjects (suppliers and consumers of goods and services) takes place; *platforms and technologies*, where competencies for the development of markets and industries are formed; and *environment* that creates the conditions for the development of platforms and technologies and effective interaction of market actors and covers regulations, information infrastructure, personnel, and information security. The program focuses on "the two lower levels of the digital economy," and specifically, the development of key institutions that create the conditions for the development of the digital economy (regulations, personnel and education, the formation of research and technological competencies) and basic infrastructural elements of the digital economy (information infrastructure and information security) (Programma 2017, 2–3).

The levels of the digital economy identified in the program do not correspond to the traditional micro-, meso-, and macro-levels established in economic theory (Jakutin 2017, 45). The first, "upper" level, according to the program, "markets and industries," entails the interaction of specific subjects (suppliers and consumers of goods and services). In other words, it is the level of an enterprise or the micro-level. Referring to the micro-level as the "upper" level of the digital economy, the program puts established economic theory on its head. The two "lower" levels, according to the program, are platforms and technologies, and "the environment."

The program states that it "focuses on the two lower levels of the digital economy" but in practice restricts itself to just one level, "the environment," broken into two components—institutions and infrastructure (Programma 2017, 2–3). The program thus sees the basic directions of creating the digital economy as the development of various institutions and infrastructure. Omitted in this statement of objectives is the digital economy itself, or to use the program's terminology, the entire second level—digital platforms and technologies. This omission is remarkable considering that the digital platform is generally recognized as the building block of the digital economy. It is defined as the system of algorithmic relationships of a significant number of market participants, united by a single information environment, which reduces transaction costs due to the use of a package of digital technologies and changes in the division of labor (Jakutin 2017, 47). The digital platform, thus, can

rightfully claim the status of the main "level" of the digital economy, without any reservations about the second, third or lower levels.

4.4.4 Cross-Cutting Technologies

The program provides support for the development of "cross-cutting" technologies but does not offer a definition of this term. Nine technologies fall within the scope of the program, specifically, big data, neurotechnology and artificial intelligence, distributed registry systems, quantum technologies, new production technologies, industrial Internet, components of robotics and sensorics, wireless technology, and virtual and augmented reality technology (Programma 2017, 3). The list of technologies will be updated as new technologies emerge and develop. The program will also be supplemented with relevant sections and road maps in the process of the implementation of specific measures in the field of health, creation of "smart cities," and public administration.

In the words of former Minister of Telecom and Mass Communications, Nikolaj Nikiforov, who presented the program at a meeting of the Council on Strategic Development and Priority Projects, cross-cutting technologies is "when a digital technology is developed once and can be used many times in various industries" (Zasedanie 2017). However, the program does not specify an economic mechanism that makes these technologies "cross-cutting." If the technology was "once" developed by someone, what is the mechanism that will allow this technology to "get away" from its owner and find its "cross-cutting" application "in various industries"? Jakutin (2017, 50) raises a number of valid questions in this regard: Who will pay for it? Who will ensure its distribution? What about copyright and intellectual property rights? The state program does not provide any answers to these questions. The choice of the nine "cross-cutting" technologies listed in the program is likewise arbitrary. According to Sneps-Sneppe et al. (2018, 38), the nine cross-cutting technologies identified in the program represent a random collection of modern technologies, and hardly the most important ones. Furthermore, it is difficult to notice the manifestation of these technologies in the program.

Compared to the original version of the program, the revised national program (2018) represents an improvement in terms of introducing a number of concrete measures for the development of "cross-cutting" technologies, which are incorporated into the new federal project "Digital technologies." These measures are aimed at achieving the goal of the national program to increase domestic expenditures on the digital economy and include (1) the creation of "cross-cutting" digital technologies predominantly on the basis of domestic research and development (R&D) and (2) the creation of an integrated system of financing projects for the development and implementation of digital technologies and platform solutions, including venture financing and other development institutions. The first objective encompasses a range of policies such as designing road maps for the development of promising cross-cutting digital

technologies, creation of digital platforms for conducting R&D in these technologies, support of Russian high-tech companies, which develop products, services and platform solutions on the basis of cross-cutting technologies for the digital transformation of priority industries, and forming demand for Russian digital technologies, products and platform solutions, in part by launching digital transformation of state corporations and companies with state participation.

4.5 Russia's Digital Economy Program: Management System

The program's management system can be characterized as flexible, with multiple centers of decision-making (Sneps-Sneppe et al. 2018; Ivanov and Malineckij 2017). In governance studies, a system with multiple semi-autonomous decision centers operating under an overarching set of rules is defined as polycentricity (Aligica and Tarko 2012; Carlisle and Gruby 2017). Despite the number of advantages ascribed to polycentric governance systems, including suitability for managing complex areas such as science, the concept of polycentricity has not been systematically applied in the study of innovation systems or science governance. This is somewhat surprising considering that the literature on science governance in Russia has framed the issue in terms of decentralization. At the same time, this literature acknowledges that the virtues of a decentralized science system are far from obvious in Russia or elsewhere since "[t]he best science is unapologetically elitist" (Graham and Dezhina 2008, vii). This section will briefly review these debates on the organization and support of science in Russia in the context of the Digital Economy Program. The objective is to assess the extent to which its management system resembles or differs from a polycentric structure by exploring its main attributes. These are: (1) the multiplicity of decision centers; (2) an overarching system of rules; and (3) a spontaneous order created by evolutionary competition between the various decision centers' ideas (Aligica and Tarko 2012, 254).

4.5.1 Multiple Decision Centers

The most striking aspect of the program's management system is the multiplicity of decision centers and the range of participants involved in the program's development and implementation. The governmental commission for the use of information technologies to improve the quality of life and the conditions of doing business is responsible for the overall control over the implementation of the Digital Economy Program (Postanovlenie 2017). Its Sub-Commission for digital economy is in charge of reviewing action plans and monitoring their implementation, approving methodological recommendations and regulations as well as resolving disagreements between participants and reviewing contradictions in draft laws. Relevant ministries oversee their own areas.[4] The Ministry

of Digital Development, Communications and Mass Media of the Russian Federation oversees the formation of research and technological competencies,[5] information infrastructure, and security while the Ministry of Economic Development administers regulatory, personnel, and educational policy. 1.8 trillion rubles will be spent in 2019–2024 on the implementation of the national program for the development of the digital economy. More than 1 trillion of these funds will be allocated from the federal budget (Pasport 2018, 75).[6]

The Analytical Center for the Government of the Russian Federation acts as the project management office for the implementation of the Digital Economy Program. It provides organizational and methodological support for the implementation of the program, including the preparation of guidelines for the development of action plans and reports on their implementation. The Center also provides information and analytical support for the activities of the Sub-Commission and ensures the operation of a system of electronic interaction of the program's participants.

An autonomous non-profit organization (ANO) Digital Economy coordinates the participation of expert and business community in the implementation, development, and evaluation of the program's effectiveness. Created by Russian high-tech companies (Yandex, Mail.Ru Group, Rambler & Co, Rostec, Rosatom, Sberbank, Rostelecom, the Skolkovo Foundation, the Agency for Strategic Initiatives, and others), the organization functions as a platform for state-business dialogue. It forms and coordinates the activities of working groups and competence centers for the program's areas and evaluates the overall implementation of the program. In addition to ensuring the interaction with business and scientific community, its functions include support of digital technology start-ups and small/medium-sized enterprises (SME) as well as foresight and digital development forecasts.

Working groups prepare proposals for action plans and participate in evaluating the effectiveness of their implementation. Competence centers are responsible for the preparation and implementation of action plans. The ANO Digital Economy initially comprised working groups and competence centers in the following five areas: information infrastructure; formation of research and technological competencies; personnel and education; regulation; and information security. State corporations Rosatom and Rostech served as competence centers for the formation of research and technological competencies while Russian Venture Company headed the working group in this area. Russia's state nuclear corporation, Rosatom, oversaw the development of new production technologies, big data, virtual and augmented reality technologies, and quantum technologies. State corporation Rostec, which promotes the development, production and export of high-technology industrial products for civil and defense sectors, was responsible for the development of neurotechnology and artificial intelligence, industrial Internet, robotics and sensor components, wireless technology, and distributed registry systems (Sistema 2017). The competence centers and leaders of working groups for the other four areas

were the Skolkovo Foundation/MTS (regulation), the Agency for Strategic Initiatives/1C Company (personnel), Rostelecom/MegaFon (infrastructure), and Sberbank/InfoWatch (security).

4.5.2 A Single System of Rules

The Russian government has made consistent efforts to develop an overarching set of rules governing the dissemination and use of information technologies in different spheres and to coordinate the various digitalization programs and initiatives within a comprehensive system of strategic planning. Thus, the Digital Economy Program is closely linked to the documents already in force on the strategic development of the Russian economy (Programma 2017, 4). It complements the goals and objectives of the National Technology Initiative and the adopted strategic planning documents, specifically the Forecast of Scientific and Technological Development of the Russian Federation for the Period until 2030, the Strategy for the Scientific and Technological Development of the Russian Federation (2016), the Strategy for the Development of the Information Society in the Russian Federation for 2017–2030, the priority project "Improving the organization of medical care through the introduction of information technologies" (2016), and other documents, including those of the Eurasian Economic Union. The adopted strategic planning documents provide for measures aimed at stimulating the development of digital technologies and their use in various sectors of the economy. For example, the adopted socio-economic development forecast of the Russian Federation envisions the active dissemination and widespread use of information technologies in the socio-economic sphere, public administration, and business (for more, see Chap. 3).

The Strategy for the Development of the Information Society in the Russian Federation for 2017–2030 is the closest strategic document to the Digital Economy Program in terms of content, with the goals of the Strategy being closely related to the program (Programma 2017, 4). Based on the Strategy, the program also takes into account its founding acts and legislative framework. These include the Federal Law No. 172-FZ "*O strategičeskom planirovanii v Rossijskoj Federacii*" (On Strategic Planning in the Russian Federation, 2014), "*Strategiâ nacional'noj bezopasnosti Rossijskoj Federacii*" (National Security Strategy of the Russian Federation, 2015), "*Doktrina informacionnoj bezopasnosti Rossijskoj Federacii*" (Information Security Doctrine of the Russian Federation, 2016) as well as related legal acts that determine the direction of the application of ICTs in Russia (Jakutin 2017, 30–31).

4.5.3 A Spontaneous Order?

Despite the existence of multiple decision-making centers and an evolving overarching system of rules governing digitalization—key attributes of polycentric governance—the nature of the order generated by this system is

ambiguous and remains a subject of controversy. At the heart of this controversy is the question of whether the program's management system represents a move toward a more effective decentralized system of science governance or a step toward further bureaucratization of science. Theoretically, this question revolves around the nature of entry into the system—free, meritocratic, or spontaneous (Aligica and Tarko 2012, 254). Practically, the respective debate in Russia has centered on the role of the Russian Academy of Sciences (RAS) in overseeing digitalization.

The critics of the Digital Economy Program have been quick to note the absence of scientific organizations in its management system. They emphasize that the RAS, the main scientific organization responsible for determining research areas, including in the field of ICT, is not included in the management and implementation of the program. The absence of scientific organizations in the program's management system is seen as evidence of an established post-Soviet trend of technological development without the involvement of domestic scientific community (Ivanov and Malineckij 2017). The criticism goes further by suggesting that the program's flexible management system with multiple centers of decision making is ill suited for governing science in Russia. According to Ivanov and Malineckij (2017, 11), such an approach has been tried before and proven ineffective in managing Russia's scientific and technological complex. It leads to the growth of the bureaucratic apparatus and increases its costs while reducing the quality of policy.

An alternative view suggests that the absence of the RAS in the government's digital economy programs and initiatives is not coincidental, and that the Academy has traditionally been dismissive of Information Technologies (IT) professionals. As a result, information technologies were "pushed out" from the RAS. Currently, only a few IT sectors are represented in the RAS such as supercomputer computing and onboard software. According to Gorbunov-Posadov (2018), the academy cannot keep up with the pace of development of the IT industry, which puts its capacity to function as a universal body of national scientific expertise into question.

These opposing views were reflected in the controversial RAS reform and its public perception. The reform, launched in 2013, originally envisaged the dissolution of the RAS, which caused a negative reaction in scientific circles and led to a wave of protests across Russia. Without going into the details of the reform process, it suffices to note that significant changes in the management system of Russian science were made in 2018. The Ministry of Science and Higher Education of the Russian Federation was established in May 2018, with all institutes of the RAS subsequently falling under its jurisdiction. Amendments to the Law on Science and the Law on the RAS redefined and strengthened the role of the academy in the management system of Russian science. Specifically, the changes reaffirmed a key role of the RAS in the design and implementation of Russia's scientific and technological development strategy (Mehanik 2019).

Pursuant to the Decree of the Government of the Russian Federation No. 16 of January 17, 2018, the Ministry of Science and Higher Education formed

Councils in seven priority areas of scientific and technological development of the Russian Federation (IMEMO 2019). The first priority area and the name of the corresponding Council is "transition to digital, intelligent production technologies, robotic systems, new materials and methods of design, creation of big data processing systems, machine learning and artificial intelligence." Its functions include formulating and monitoring of scientific and technological programs and projects in this area as well as providing expert and analytical support for the implementation of Russia's scientific and technological development priorities. Among the members of the Council are academicians, representatives of leading research centers and universities, big business, federal executive bodies, and state corporations (RAS 2018).

Thus, the Council oversees digitalization within the framework of the Strategy for the Scientific and Technological Development of the Russian Federation but is far from the only institution responsible for the formation of Russia's digital economy. Other programs and initiatives in this area include the Digital Economy Program and the National Technology Initiative, with their own teams and management systems. Additionally, most ministries have their own digitalization programs. Whereas critics insist that the duplication of functions and incontinency between various programs within this framework is a result of a poorly coordinated system of management (Chujkov 2019), it could also be argued that it is a result of a delicate compromise between the government, the RAS, and other stakeholders. Even though the role of the Academy has been strengthened, the existence of multiple decision-making centers prevents the monopolization of scientific expertise and allows competition between different ideas to take place. Thus, the polycentric structure of the Digital Economy Program's management system is amplified on a broader scale of Russia's digital economy governance where this program coexists with other digitalization initiatives.

4.6 Criticism of the Program and Weaknesses of the Government's Digitalization Strategy

4.6.1 Imitation and Copying of Western Models

In the post-Soviet economy, the practice of borrowing ideas and approaches from foreign programs has become widespread. According to Ivanov and Malineckij (2017, 4), the Digital Economy Program, which is based on the recommendations of the World Economic Forum, was no exception. This copying of Western models inevitably affects the content and quality of the program. The emphasis is not on essential, critical matters but on external issues such as places in the ratings and keeping up with technological trends. Furthermore, the program does not proceed from the ability to produce new types of products but from the interests of a "qualified consumer." In the broader sense, the common criticism of the program is that it does not deal

with the economy as such or, more precisely, changing the technological base, which would lead to socio-economic transformations. The program focuses predominantly on the development of key institutions and infrastructure of the digital economy while "practically nothing is said about production, distribution or consumption" (Ivanov and Malineckij 2017, 4). As Loginov (2017) notes, "a lot and even too much is said about the 'digital' and practically nothing about the 'economy.'" The program does not provide a clear answer as to how the "digital" would fit into the economy.

The fallacy of the catch-up logic of the program is highlighted by the government's expert council in their conclusion on the program's first draft. The goal of the program, according to the expert council, was not to advance Russia's development but rather to raise the digitalization level of its economy to the current level of developed countries by 2025. This means that by that time Russia will need a new program for the development of the digital economy, since one of the fundamental characteristics of the ICT sphere is the rapid introduction of new technologies, the emergence of which cannot be foreseen today (Demidov 2017).

4.6.2 Emphasis on Services to the Detriment of Production

Since the program is implicitly aimed at raising the digitalization level of the Russian economy to that of developed countries, it makes sense to briefly examine the industries and services that comprise the high-tech sector in developed economies. The US statistics, for example, distinguishes five high-tech manufacturing industries—pharmaceutical industry, semiconductor manufacturing, production of scientific and measuring equipment, production of communication equipment, and aerospace industry. The foundation of all these industries is electronics (Ivanov and Malineckij 2017, 8). There are also five service industries that comprise the high-tech sector of the US economy—business, financial, and communication services, education, and healthcare. Looking at the Digital Economy Program from this perspective, it is possible to conclude that it is focused on service industries while neglecting the high-tech manufacturing sector, the development of which is blocked in Russia.

One of the main criticisms of the program is that it does not provide measures for the development of Russian electronic components and systems (*èlementnaâ komponentnaâ baza*). At the same time, many of the program's objectives require the development of electronic components (Loginov 2017). Specifically, the digital transformation of industry, or Industry 4.0, cannot occur without a national technological base, including the industry of domestic micromechanics and nanoelectronics (Sitnikov 2017). Micro-Electro Mechanical Systems (MEMS) top the list of technologies necessary for the development of Industry 4.0. In Russia, these technologies are developed within the framework of Rusnano's programs.[7] Critics consider them ineffective, lamenting that Russia still has "ancient" technological competencies at the level of classical mechanics and limited laser processing capabilities. That is, it

is capable of producing parts with an accuracy of 0.1 mm on its equipment whereas the standard for global leaders in this field is 0.0001 mm.

One possible initiative in this regard could be the creation of a national 5G network based on Russian equipment (Loginov 2017). However, the program's activities in this field are limited to "assessing the capabilities" of the domestic industry to produce telecommunications equipment. As Loginov (2017) accurately points out, the domestic capabilities of building 4G networks were already assessed in 2011, but as a result, the networks were modernized using Chinese equipment. The program includes a number of target indicators for the development of domestic telecommunications industry, specifically increasing the share of domestic products in the purchases of software by federal and regional executive bodies and state-owned companies. However, in the absence of concrete measures for the revival of Russian telecommunications industry, it is unlikely that the program will meet these targets (Sneps-Sneppe et al. 2018, 39).

4.6.3 Preservation of Technological Dependence

Most of the communications equipment and software in Russia is of foreign origin. Russia is critically dependent on the import of IT equipment (from 80% to 100% for various categories) and software (about 75%) (Aptekman et al. 2017, 43). In 2016, the volume of sales of smartphones in Russia amounted to about 30 million units; the sales of personal computers—about 5 million units. The share of products of Russian manufacturers, which are built almost completely on the basis of foreign components, is miniscule in these volumes, just a few percent (Betelin 2017, 24). As another example, the networks of Rostelecom, Russia's largest provider of digital services, have until recently been the arena of struggle between two American companies—Cisco Systems and Juniper Networks (Sneps-Sneppe et al. 2018, 37). Rostelecom's main project is a high-speed internet protocol (IP) network built entirely with the products developed by Juniper Networks.

The preservation of technological dependence runs counter to the Strategy of National Security and the Strategy for the Scientific and Technological Development of the Russian Federation (Ivanov and Malineckij 2017, 7). The critical dependence on imported components carries serious risks for the national security. It also blocks the development of many sectors of the domestic industry. The existing experience of using borrowed solutions in microelectronics indicates that Russian enterprises have access to technology and technical solutions with a lag of two or more generations, and the amount of payments for their use ranges from 30% to 80% of development costs and up to 50% in mass production (Betelin 2017, 23). This is one of the main reasons why the semiconductor industry in Russia is not significant in economic or social terms. There is a risk that the implementation of the Digital Economy Program and the related National Technology Initiative will not lead to Russia gaining any significant share of the new global high-tech markets. Without

developing domestic electronics industry, the transition to the digital economy can be considered only in the context of purchases of electronic equipment abroad, including for defense and security. This would require addressing an additional problem of "non-declared capabilities" or the detection of hidden functions of the supplied equipment, permitting unauthorized control (Ivanov and Malineckij 2017, 8).

4.6.4 Lack of Scientific Support

One of the criticisms of the program's management system is the absence of scientific organizations (Ivanov and Malineckij 2017, 11). With regard specifically to the ICT infrastructure, Sneps-Sneppe et al. (2018, 41) note that Russian scientific research institutes, industrial science, and professional scientists are not involved in addressing systemic issues of infrastructure development and the preparation of relevant conceptual documents. The lack of scientific support adversely affects the quality of the program, which does not provide sufficient justification for the key role of the digital economy in ensuring Russia's economic leadership.

Available studies suggest that the products of the leaders of the global markets of semiconductors, electronic products, and software, such as INTEL, AMD, IBM, and Microsoft currently form the basis for the development of the digital economy (Betelin 2017, 24). In these conditions, the main risks and challenges for the formation of Russia's digital economy stem from the lack of similar companies in Russia that carry proportionate economic and social weight. While the program envisions the creation of ten large high-tech companies by 2024, it lacks actual measures for stimulating domestic electronics industry and relies on modernization of the communications network based on imported equipment. Such modernization efforts are likely to result in the reduction of the size of the digital economy in Russia rather than its growth (Loginov 2017).

Even though the Strategy for the Scientific and Technological Development of the Russian Federation (2016) defines the key role of Russian fundamental science in ensuring the country's readiness for grand challenges and timely assessment of the risks associated with scientific and technological development, in practice the program relies on the use of foreign scientific results and technologies (Strategija 2016; Ivanov and Malineckij 2017, 12). One of the stated objectives of the program is the creation of a support system for exploratory and applied research on the digital economy, which is supposed to ensure technological independence of each of the globally competitive cross-cutting technologies (Programma 2017, 11). However, relevant activities do not include basic (fundamental) research. Thus, the criticism of such an approach is that it cannot in principle ensure technological independence in ICT because new technologies can be created only on the basis of systematic results of exploratory and fundamental research (Ivanov and Malineckij 2017, 12).

4.6.5 Lack of Reliable ICT Infrastructure

A number of studies note that the ICT infrastructure is relatively well developed in Russia, with digital services available for the majority of the country's population (Aptekman et al. 2017, 36). On this basis, some analysts even point out that it is "completely unnecessary" for the government "to try to control or stimulate this process" (Loginov 2017). This view suggests that Russian telecom companies are able to deal with the infrastructural issues on their own, at the level of their commercial needs.

Sneps-Sneppe et al. (2018) offer an alternative point of view from the perspective of telecom professionals. The basis of information and communication infrastructure, the information space of any country, is the next-generation network (NGN), which provides a user with universal broadband access to an unlimited range of ICT services. Has such an infrastructure been developed in Russia, and who is building it? The construction of next-generation networks in Russia has been carried out by private capital to make a profit from providing access to the Internet and related services. This is done without taking into account the task of creating the foundation of the country's digital infrastructure—a single telecommunications network of the Russian Federation, as required by the current law "*O svâzi*" (On Communications) and the interests of the state and society. The result, according to the authors, is the uncertainty of the architecture, location, and connectivity of the traffic exchange nodes of the composite network and the inability to manage it even in emergency situations. This "conglomerate of private fragments of the global Internet" cannot be used as an infrastructure for the networks that require high reliability and security of information exchange, which relates to the objectives of the Digital Economy Program (Sneps-Sneppe et al. 2018, 40–41). The ICT infrastructure cannot be developed solely on the commercial basis. It has to meet the needs of the state, governance, and national security, in addition to being an increasingly important factor in improving the quality of life of the citizens.

Examining the Digital Economy Program from this perspective, it is possible to make the following observations. First, despite the emphasis on the infrastructure development in the program and the key role of Rostelecom in this area, the main efforts are aimed at the provision of new ICT services. The program's activities do not include the development of technical means (Sneps-Sneppe et al. 2018, 40). The program is oriented toward the spread of the Internet and higher-level tasks such as satellite communications and 5G network without addressing the prior issue of the lack of a unified telecommunication network. Second, the risks associated with the ongoing modernization of private networks on the basis of next-generation technologies such as Software-Defined Networking (SDN), Network Function Virtualization (NFV), and 5G are not adequately addressed in the program. Third, the program focuses on the Internet, or regulation of IP packets, whereas the existing law "On Communications" is still oriented toward traditional networks and communication services. The actual meaning of such basic terms of the law as "federal

communications," "a single (*edinaâ*) telecommunication network," and "a public telecommunications network" has changed dramatically. To date, this has not been reflected in the legal framework and mechanisms for regulating the development of the domestic telecommunications sector (Sneps-Sneppe et al. 2018, 40). Despite the long list of measures in the program aimed at improving legal regulation of the digital economy, these specific problems of the current legal framework are not addressed.

4.7 Conclusion

The state program "Digital Economy of the Russian Federation" can be seen as the government's latest attempt to approach the task of Russia's modernization in new technological conditions. For Russia to fully harness the economic and social benefits of the digital revolution, digital technologies have to become the key factor in the modernization of Russian industries as well as the creation of completely new industries and markets, which requires a targeted and systemic state support based on a clear and coherent strategy. In this regard, the Digital Economy Program is an important milestone representing the Russian government's concerted effort to envision the medium-term future of the digital economy in Russia and draft a comprehensive strategy in this area, even as it falls short in terms of its potential transformative effect on Russian industry.

Given the current state of development of domestic ICT equipment and software, the digitalization of Russian economy deserves the status of a strategic task. Such a strategic orientation, especially in the broader context of a shift from the management of hydrocarbon exports to technology governance, is extremely important. At the same time, the experience of post-Soviet development shows that the main problem lies not in ideas but in their implementation. One of the main reasons past economic initiatives were not successful is that they were made without sufficient scientific assessment based on very general considerations (Ivanov and Malineckij 2017, 3). As the analysis shows, some of the same mistakes are repeated in the case of the Digital Economy Program.

Even though the program's management system with its multiple decision centers and an evolving overarching system of rules governing digitalization resembles a polycentric structure, which in theory is suitable for managing complex areas such as science, the advantages of this system in Russia's case seem questionable. Alternatively, more attention should be paid to the nature of entry into this system. At present, the multiplicity of decision centers in the program's governance structure masks the insufficient involvement of scientific organizations, which is reflected in the program's content. The lack of scientific support adversely affects the quality of the program, which does not justify the role of the digital economy in ensuring Russia's economic leadership or provide measures for stimulating domestic electronics industry.

Although the Strategy for the Scientific and Technological Development defines the key role of Russian fundamental science in the assessment of

challenges associated with scientific and technological development, in practice the program relies on foreign scientific results and technologies. Thus, the government attempts to address an important technological problem without using domestic scientific potential. This affects the content and quality of the program, which proceeds from the interests of a "qualified consumer" and focuses on the spread of the Internet and provision of new ICT services while neglecting the critical state of Russian electronic components and systemic issues of ICT infrastructure development.

The program is too concise and general, and consequently, does not provide sufficient justification for the key role of the digital economy in ensuring Russia's economic leadership or allow an adequate assessment of possible risks and challenges. The program defines multiple target indicators but does not provide evidence that the achievement of these indicators will reduce Russia's technological gap with leading countries. Furthermore, it lacks actual measures for stimulating domestic electronics industry and relies on the modernization of the communications network based on imported equipment. The critical dependence on imported components blocks the development of many sectors of the domestic industry and runs counter to the Strategy of National Security and the Strategy for the Scientific and Technological Development of the Russian Federation. Without developing domestic electronics industry, the transition to the digital economy can be considered only in the context of purchases of electronic equipment abroad, which is likely to result in the reduction of the size of the digital economy in Russia rather than its growth.

Notes

1. Unless otherwise noted, all translations are author's own.
2. Presidential Decree No. 204 of May 7, 2018 "*O nacional'nyh celâh i strategičeskih zadačah razvitiâ Rossijskoj Federacii na period do 2024 goda*" (On the national goals and strategic objectives of development of the Russian Federation for the period up to 2024).
3. On July 19, 2018, the Council for Strategic Development and Priority Projects was reorganized into the Council for Strategic Development and National Projects ("*Ob uporâdočenii*" 2018).
4. The Digital Economy Program (2017) had five areas. In the process of its transformation into the national program (2018), the areas became federal projects and their number increased to six.
5. This area was changed to "Digital Technologies" in the national program. The federal project "Digital Public Administration" was also added to the areas overseen by the Ministry of Digital Development, Communications and Mass Media (Pasport 2018).
6. ICT analysts see this amount of funding as insufficient (Ustinova 2019). The largest amount of funds is allocated to information infrastructure whereas the funding of regulation and information security is quite modest. The final budget of the national program is also smaller compared to earlier estimates of 3.5 trillion rubles in total funding (Posypkina and Balenko 2018).

7. Rusnano was the largest investor in SiTime, "an industry leader in development of MEMS-based high-performance oscillators and silicon timing solutions" that was acquired by Megachips in October 2014 (Rusnano 2011; Yoshida 2014).

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